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NATIONAL DAM SAFETY PROGRAM. LOWER NORTON RESERVOIR DAM NUMBER --ETC(U)
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TENNESSEE RIVER BASIN

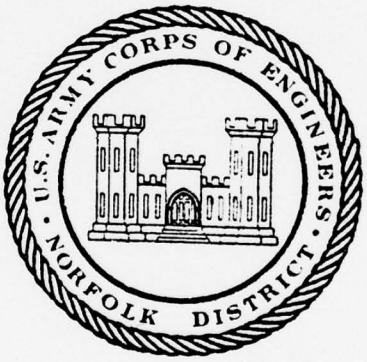
Name Of Dam: LOWER NORTON RESERVOIR

Location: WISE COUNTY, VIRGINIA

Inventory Number: VA 19507

LEVEL II

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



PREPARED FOR

NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

BY

GILBERT ASSOCIATES, INC.

AUGUST, 1978

REVISION NO. 1 TO PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

LOWER NORTON

The cover color is revised to white. The actual cover will not be changed. Each recipient of a copy of this report should notate the existing cover. In addition, add to Section 7, the following paragraphs:

7.1.1 Using the Corps of Engineers screening criteria for initial review of spillway adequacy, it has been determined that the embankment would be overtopped for all storms exceeding approximately 24% of the PMF. The spillway is therefore, adjudged as seriously inadequate and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

7.2.1 In accordance with paragraph 7.1.1, it is recommended that within two months from the date of notification to the Governor of the Commonwealth of Virginia, the owner engage the services of a professional consultant to determine by more sophisticated methods and procedures the adequacy of the spillway. Even though the seriously inadequate spillway would produce a dam failure primarily from hydrologic reasons, remedial measures in structural or geotechnical areas may be needed to remove the dam from an unsafe classification. Within 6 months of the date of notification to the governor, the professional consultant's report of appropriate remedial mitigating measures should have been completed and the owner should have an agreement with the Commonwealth of Virginia to a reasonable time frame in which all remedial measures will be complete. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER VA 19507	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Lower Norton Reservoir Wise County, Virginia		5. TYPE OF REPORT & PERIOD COVERED Final report 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Gilbert Associates, Thomas Roberts		8. CONTRACT OR GRANT NUMBER(s) DACW 65-78-D-0014
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U. S. Army Engineering District, Norfolk 803 Front Street Norfolk, VA 23510		12. REPORT DATE August 1978 13. NUMBER OF PAGES 50
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) 58 p.		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

National Dam Safety Program. Lower Norton Reservoir Dam Number (VA 19507), Tennessee River Basin, Wise County, Virginia. Phase I Inspection Report.

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams - VA
National Dam Safety Program Phase I
Dam Safety
Dam Inspection

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

(See reverse side)

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

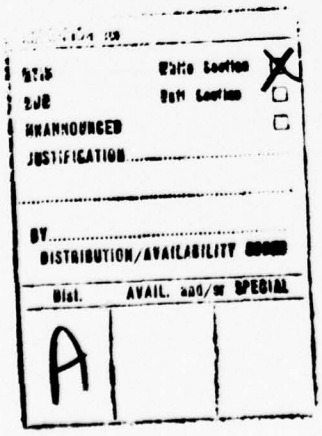
20. Abstract

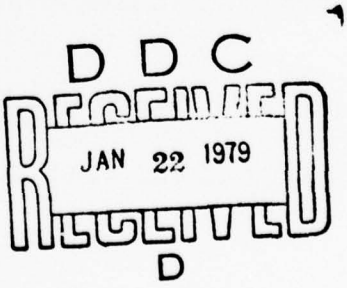
Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

LEVEL II





PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Lower Norton Reservoir Dam
State:	Virginia
County:	Wise
USGS Quadrangle Sheet:	Norton, Virginia
Stream:	Benges Branch -- Powell River

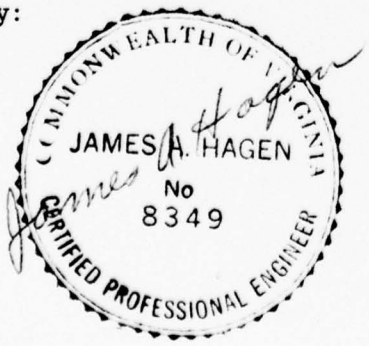
This a 63-foot high, 350-foot long concrete arch dam. The central 100 feet of the dam is the overflow section. The dam is used for primary storage of water for the city of Norton. The visual inspection did not indicate that the dam was in an imminently hazardous conditon; however, there are items of concern with require the owner's attention. See Appendix VI, Conditions.

The spillway capacity of this dam does not meet the U.S. Corps of Engineers' screening criteria described in paragraph 5.8 and is classified as "seriously inadequate." The spillway will pass only the 100-year flood; the probable maximum flood (PMF) and one-half the PMF both overtop the dam. The owner should develop within 30 days after receipt of this Report an early warning system for notifying downstream residents of any impending hazards. Until such time as the warning system can be implemented, surveillance of the dam should be performed during periods of high water. The owner should give consideration to enlarging the spillway capacity in the future.

Stability calculations are not available; however, the dam has withstood previous storms. The owner is requested to obtain stability calculations prepared by a competent consulting engineer within one year after receipt of this Report. The owner should consider maintaining the reservoir at a lower level until it can be shown that the dam is stable and has conventional margins of safety.

The dam has significant leakage at at least three different locations. The leakage sources should be monitored and investigated starting immediately, and corrective measures should be carried out within 6 months. There is an excessive growth of trees on both abutments. The trees should be removed and the disturbed areas adequately stabilized within 30 days after the receipt of this Report.

Prepared By:



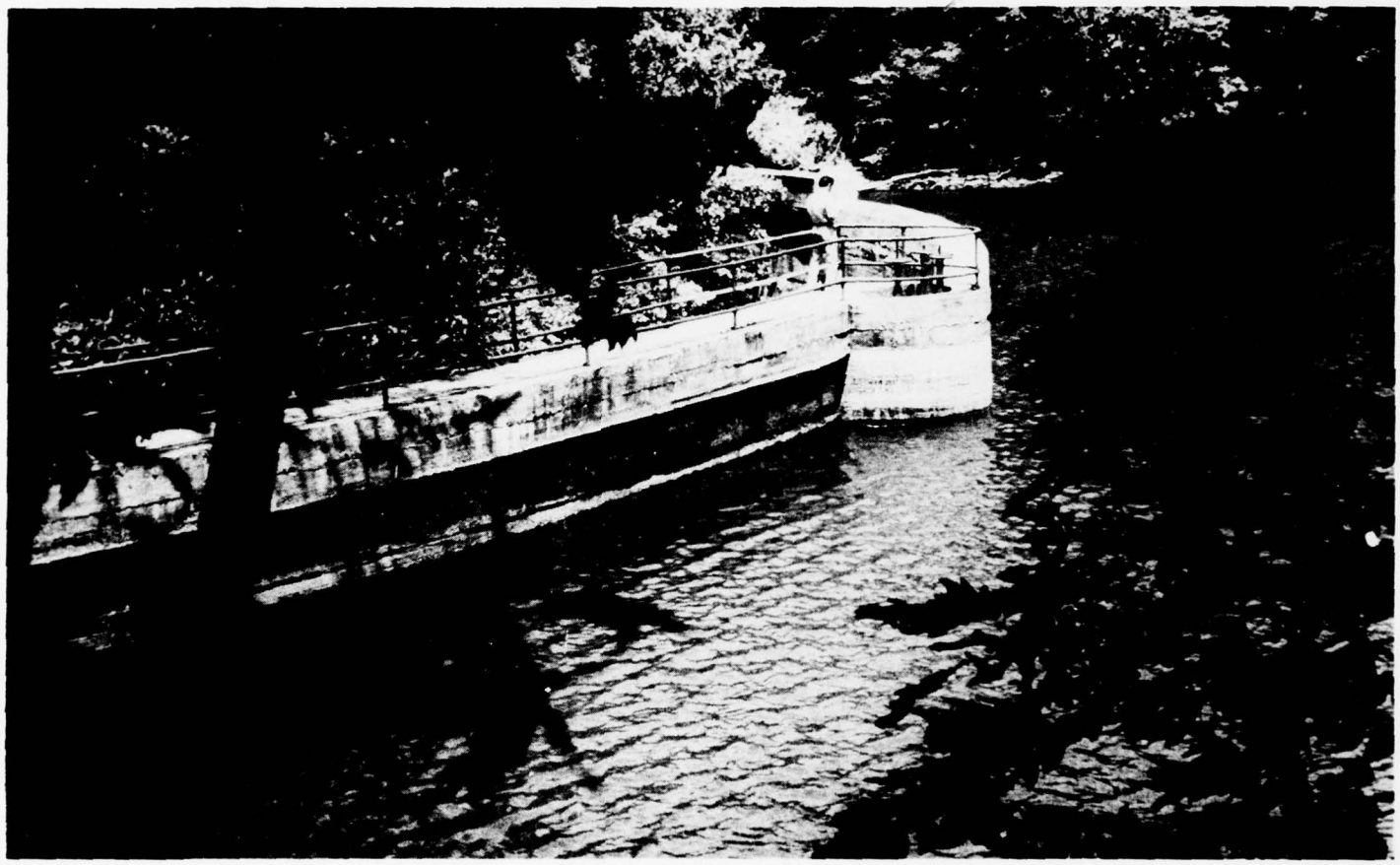
APPROVED: Original signed by:
Douglas L. Haller

Douglas L. Haller
Colonel, Corps of Engineers
District Engineer

28 AUG 1978
Date

Original signed by
JAMES A. WALSH
Submitted By:

Original signed by
ZANE M. GOODWIN
Recomended By:



June 1978

OVERVIEW PHOTO - LOWER NORTON RESERVOIR DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM: Lower Norton Reservoir Dam ID No.: VA 19507

SECTION 1 - PROJECT INFORMATION

1.1 General

1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the U.S. Corps of Engineers, to initiate a national program of safety inspections of non-Federal dams throughout the United States. The Norfolk District of the U.S. Army Corps of Engineers has been assigned the responsibility of the inspection of the dams in the Commonwealth of Virginia. Gilbert Associates, Inc. has entered into contract with the Norfolk District to inspect this dam, Gilbert Work Order No. 06-7750-004.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (Reference 6 of Appendix IV) and contract requirements between Gilbert Associates, Inc. and the Corps of Engineers. The objectives are to expeditiously identify whether this dam apparently poses an immediate threat to human life or property, and to recommend future studies and/or any obvious remedial actions that may be indicated by the inspection.

1.2 Project Description

1.2.1 Dam and Appurtenances: The Lower Norton Reservoir Dam is a concrete arch dam about 350 feet long and 63 feet high. The top of the dam is about 4 feet wide and is at elevation 3,218 feet. The base of the dam is about 13 feet wide.

A central, 100-foot long section of the dam serves as the overflow spillway at an elevation of 3,215.9 feet.

The intake tower has five multi-level 12-inch diameter sluice gates to control the flow and the withdrawal elevation. A below grade 12-inch or 16-inch pipeline is connected with the tower to convey water to an 8-inch line supplying the water treatment plant and to a normally closed but valved pipeline leading to the river, according to Mr. Gilly, an employee of the city of Norton. The owner's crew stated that it is a 12-inch pipe whereas the drawings furnished by the designer show a 16-inch pipe.

Although the available drawings do not show it, a sluice gate about 3 feet in diameter was installed above the downstream grade to the left of the overflow section, apparently to drain the reservoir. This valve is rusted and filled with sediments; therefore, it is not operational. The handwheel has been removed from this valve.

1.2.2 Location: The Lower Norton Reservoir Dam is located in the Jefferson National Forest on the Benges Branch of the Powell River downstream of Upper Norton Dam and about 1 mile south of the city of Norton, Virginia.

1.2.3 Size Classification: The dam is classified as an "intermediate" size structure because of its height of 63 feet, in accordance with Section 2.1.1 of Reference 6 of Appendix IV.

1.2.4 Hazard Classification: This dam is located upstream of the western portion of the city of Norton, Virginia. The dam should, therefore, be classified as high hazard in accordance with guidelines contained in Section 2.1.2 of Reference 6 of Appendix IV. The hazard classification used to categorize dams is a function of location relative to property and people only, and has nothing to do with its stability or probability of failure.

1.2.5 Ownership: City of Norton, Virginia.

1.2.6 Purpose: Water supply for the city of Norton.

1.2.7 Design and Construction History: The dam was designed by Chester Engineers of Pittsburgh, Pennsylvania, in about 1927. Reportedly, it was constructed in 1929. The drawings, as attached in Appendix I, are available from the designer.

1.2.8 Normal Operational Procedure: The intake tower has five 12-inch sluice gate valves at various levels to control the quality of water being withdrawn. These valves are not in an operating condition according to the owner's representatives. Presently all these valves are in the open condition.

The city water supply demands are furnished by an 8-inch line with a normally open upper valve just downstream of the dam, which is connected to a larger (12-inch to 18-inch) pipe leaving the dam. The flow can be manually controlled near the treatment plant and automatically controlled inside the treatment plant.

The sluice gate (about 3 feet in diameter) to drain the reservoir is inoperable (see Photographs in Appendix II). The available drawings (see Appendix I) do not show this gate.

1.3 Pertinent Data

1.3.1 Drainage Area: 0.80 square miles.

1.3.2 Discharge at Dam Site: Maximum flood at dam site not known.

Principal spillway with pool level at top of dam . . . . . 1,010 c.f.s.

1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown in Table 1.1:

Table 1.1 DAM AND RESERVOIR DATA

Item	Elevation feet m.s.l.	Water Surface Area - acres	Reservoir Capacity Acre-feet	Reservoir Capacity Watershed inches	Reservoir Capacity Length miles
Top of Dam	3,218	8.3	200	4.7	-
Ungated Spillway Crest	3,215.9*	7.8	182	4.3	0.3
Streambed at Dam	3,155	0	0	0	0

* A drawing by Chester Engineers shows 3215.0 feet. This elevation is based on field measurements from the top of the dam.

SECTION 2 - ENGINEERING DATA

2.1 Design: The dam was designed by Chester Engineers of Pittsburgh, Pennsylvania. The design drawings (not as-built) are available from the designer (see Appendix I). No other design data were available at the time of this inspection.

2.2 Construction: The dam was probably built in 1929. The present city staff could not locate any records of construction.

2.3 Operation: There is no written record of operation data. However, city water supply demands are controlled at three locations.

Records of water levels measured down from the top of the overflow spillway crest have generally been made monthly or bimonthly since June 1975, and are kept at the water treatment plant.

2.4 Evaluation: Much information on design, construction, and operation is not available. The boring logs given on the available drawing (Figure 2 of Appendix I) indicate that the borings were shallow and taken only 2 feet into the solid rock. The rock strata are also not adequately described. Among the missing items are:

a. Design calculations (including stability).

b. Construction specifications, including concrete mixes.

c. As-built drawings.

d. Construction records (inspection and progress).

e. Operational records of flows over the spillway.

f. A record of the maximum water surface elevation in the reservoir.

g. Seepage analyses at abutments and under the dam.

h. A subsurface exploration report giving data on the test pits and holes indicated on the plans.

i. Test reports on the concrete.

j. Construction details of the horizontal joints.

k. The name(s) of the contractor(s) and dates of construction.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

3.1.1 General: The base of the dam can be reached by four-wheel drive vehicles and most maintenance equipment. For photographs see Appendix II.

3.1.2 Dam: It appears from the form-work impressions that the dam was constructed in horizontal lifts of 5 feet or less. Significant leakage of water was noticed at at least three different places. It appears that water is coming out of the construction joints. Three of these leakage spots were in the central overflow section of the dam. There were areas of severe scaling of the concrete, and erosion at horizontal joints was common.

There are no signs of displacement, tilting, or cracking of the dam. There was no leakage or any sign of distress at any of the abutments. The abutment rock at both ends, as visible from the downstream side, consisted of competent, gray sandstone, probably of Pennsylvanian Age. The dip angle of the strata at the left abutment was approximately 20 degrees towards the stream; the strike-line was at an angle to the centerline of the dam of approximately 45 to 60 degrees. Approximately 30-foot to 60-foot tall trees were noticed at both the abutments.

The foundation rocks, as evident from the exposed rocks at the downstream channel, are also probably of Pennsylvanian Age, consisting of sandstone and shale. These rocks appeared dense and resistant to weathering and erosion.

The dimensions of the overflow section of the dam generally agreed with the drawings. There was some spalling of concrete on the spillway crest except for 10-foot sections on both ends of the structure.

3.1.3 Appurtenant Structures: The controls on the intake tower openings (five 12-inch sluice gate valves) are inoperable but are presently in the open condition. However, according to the water treatment plant staff, some of these openings may be blocked by silt and sediments in the reservoir. The 3-foot diameter sluice gate is not operable.

3.1.4 Reservoir and Downstream Area: The downstream channel side slopes were rocky and densely wooded, but stable.

The reservoir slopes were densely wooded and apparently stable.

3.2 Evaluations: The foundation and the abutments of the dam appear to be in sound condition, posing no imminent hazard. The concrete in the dam shows areas of scaling and spalling, and erosion at the construction joints. The leaks at the construction joints can create serious erosion problems resulting in progressively increasing the size of the holes and, consequently, increasing the leakage making it more difficult to repair as time passes. Therefore, the holes should be closed and the leakage stopped in the next six months. The tree growth at the abutments can undermine the safety of the abutments by decomposition of the rock strata resulting in deterioration of its load-bearing capacity.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: There are apparently no formal, recorded, operating procedures for this dam. The flow from the reservoir can be controlled at several different locations, including three places on the 8-inch water supply line (one within the water treatment plant), and two on the bypass to the river. A valve on the bypass is reportedly operated to flush debris off a screen at the entrance to the 8-inch supply line.

4.2 Maintenance: There is no apparent regular maintenance procedure for this dam or for the operating facilities at the dam other than maintaining the 8-inch water supply line.

4.3 Description of Warning System in Effect: There is no formal warning system at this dam.

4.4 Evaluation: A plan for periodic inspection and maintenance of the dam and operating facilities is lacking. There is no operating procedure for flood control and no warning system at this dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC DESIGN

5.1 Design: None available.

5.2 Hydrologic Record: None available, except that water levels of the reservoir have been recorded since June 1975 (generally once or twice a month) by the city water treatment plant crew. There were no flow measurements made.

5.3 Flood Experience: According to the city's water treatment plant crew, the dam has never been overtopped.

5.4 Flood Potential: Various flood hydrographs were routed through the reservoir, the results are presented in paragraph 5.6 and Table 5.1.

5.5 Reservoir Regulation: The main sluice gate is inoperable. The only controls in operation are on the 8-inch water supply line which releases water for the city's water supply demands and the bypass line to the river.

5.6 Overtopping Potential: The PMF, one-half the PMF, and the 100-year flood hydrographs were developed for the Lower Norton Reservoir drainage area and routed through the reservoir. Table 5.1 summarizes the results of this procedure.

The hydrographs were developed and routed by using the HEC-1 computer program (Reference 1 of Appendix IV) and appropriate precipitation, unit hydrograph, and storage volume versus outflow data as input. The inflow hydrographs were developed by combining the respective outflow hydrographs from the Upper Norton Reservoir (Reference 5 of Appendix IV) with those developed from the additional Lower Norton drainage area. Probable maximum precipitation and 100-year precipitation data were obtained from U.S. Weather Bureau publications (References 3 and 4 of Appendix IV). Losses were estimated at an initial loss of 1.0 inch and a constant loss rate of 0.30 inch/hour. The triangular unit hydrograph was developed from the drainage area and estimated time to peak (Reference 2 of Appendix IV). Information from design drawings and field measurements and the design capacity curve were used to compute the storage-outflow relation.

Table 5.1 RESERVOIR PERFORMANCE

Item	Flood Hydrograph PMF	1/2-PMF	100-Year
Peak Flow, c.f.s.			
Inflow	5,200	2,200	890
Outflow	5,200	2,200	870
Peak Elevation, feet m.s.l.	3,220.2	3,218.8	3,217.8
Ungated Spillway			
Depth of Flow, feet [a]	3.1	2.1	1.3
Average Velocity, f.p.s.	10.0	8.2	6.5
Overtopping of Dam [b]			
Depth of flow, feet [a]	1.4	0.5	--
Average Velocity, f.p.s.	6.7	4.0	--
Duration, hours	5.3	2.0	--
Tailwater Elevation, feet	--	--	--

Notes:
(a) Critical depth.
(b) This is a concrete dam with rocky abutments.

5.7 Reservoir Emptying Potential: The Lower Norton Reservoir can be drawn down by using the bypass line to the river. The bypass line is controlled by a valve located at the base of the dam. Size information was not available; therefore, it was conservatively estimated that the pipe is

12-inches in diameter. This allows drawdown of the reservoir from the spillway crest, elevation 3215.9 feet, to elevation 3,160 feet in about four days.

5.8 Evaluation: The results indicate that the spillway is not capable of passing the PMF nor one-half the PMF without overtopping the dam. This spillway is "seriously inadequate" according to the U.S. Corps of Engineers' criteria in Reference 7 of Appendix IV. The spillway passes the 100-year flood without overtopping the dam. The peak elevation during one-half the PMF is 3218.8 feet m.s.l. and overtopping will last about 2 hours. The spillway is capable of passing 24 percent of the PMF. These conclusions pertain to present day conditions and the effect of future development on hydrology has not been considered.

SECTION 6 - DAM STABILITY

6.1 Stability Analysis: No design or construction information is available for this dam. The information from the available drawings and visual inspection is not adequate.

6.2 Foundation and Abutment: The visual inspection did not show any abutment leakage or apparent overstressing effects at the abutments. No evidence of foundation underseepage was found. The abutments and the foundation of the dam seem to be in stable condition. A small head of water flowing over the dam during the PMF or one-half PMF is not likely to erode the rocks at the toe areas of the dam.

6.3 Evaluation: There is inadequate information available for a meaningful stability analysis of this dam. The excessive tree growth in the vicinity of the abutments could result in deterioration of the strength and integrity of the abutment rock.

The dam is located within Zone 2 on the Algermissen Seismic Risk Map of the United States (1969 edition) and there are uncertainties with respect to the static stability of the dam, as described above. Therefore, in accordance with paragraph 3.6.4 of Reference 1 of Appendix IV, assessments should be made regarding seismic stability, based on the studies outlined in paragraph 7.2-c.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

The assessment, recommendations, and remedial measures contained in this Report are based on the provision of Appendix VI, Conditions.

7.1 Dam Assessment: There are no major visual findings such as cracking of the concrete structure, uneven settlement, or excessive leakage at the abutments or foundation which would indicate that the dam is in an immediately hazardous condition. However, without information on the foundations materials, the internal condition of the concrete dam, and stability computations, the actual condition of the dam cannot be completely evaluated. The spillway is capable of passing a 100-year flood with 0.2 feet freeboard and 24 percent of the PMF without overtopping the dam.

There are several items of concern.

a. The dam cannot pass one-half the PMF without overtopping and possible damage to the dam. The spillway capacity is rated "seriously inadequate" based on the U.S. Corps of Engineers' criteria described in paragraph 5.8.

b. There is a significant quantity of leakage from the construction joints of the concrete dam.

c. There is inadequate information available to evaluate the stability of the arch dam.

d. Large trees have grown on both the right and left abutments of the dam, which may deteriorate the strength of the load-bearing rock strata.

7.2 Recommendations/Remedial Measures: To address the concerns stated above, the following are recommended:

a. The owner should consider maintaining the reservoir at a lower level until the studies recommended are performed and appropriate remedial measures taken.

b. The areas experiencing leakage should be continuously monitored and investigated starting immediately, and necessary repairs carried out within 6 months to stop the leakage. However, in the meantime, if a significant change in the leakage is noted, then appropriate measures should be taken immediately.

c. The owner should provide to the Commonwealth of Virginia all existing computations for stability analysis of the dam within 45 days of receipt of this Report. If the original computations are not available, then the owner should enlist the services of competent consultants to perform such studies and submit the report within one year after receipt of this Report.

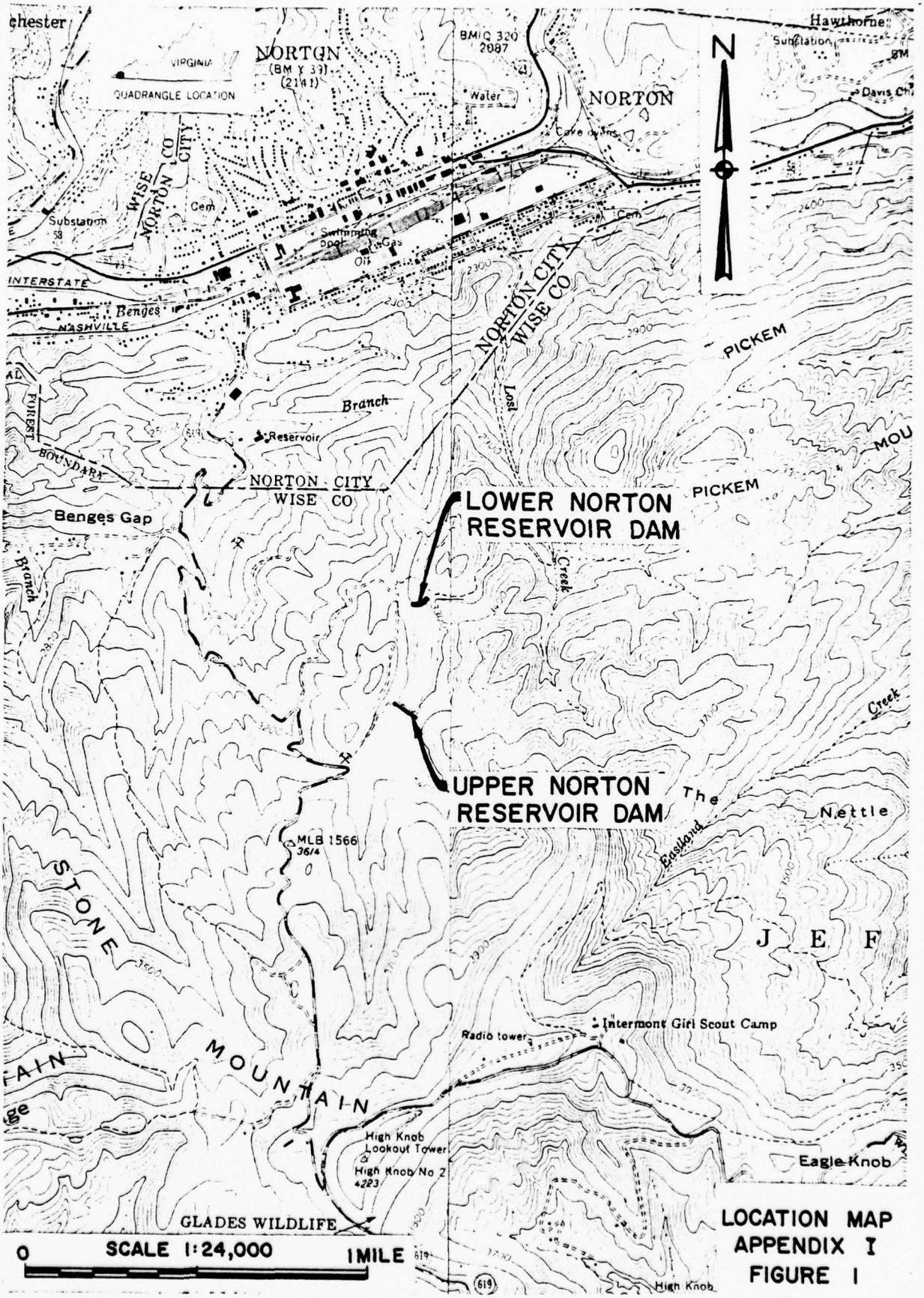
d. A method of providing early warning to downstream residents of impending floods resulting from a failure of the dam or its abutments should be developed within 30 days and implemented within 3 months. Until such time as the warning system can be implemented, it is recommended that during periods of unusually high runoff, the owner should provide surveillance of the dam.

e. Trees in the vicinity of both embankments should be removed soon. Where large trees and roots are removed, the holes remaining should be immediately filled with concrete and/or grouted with cement.

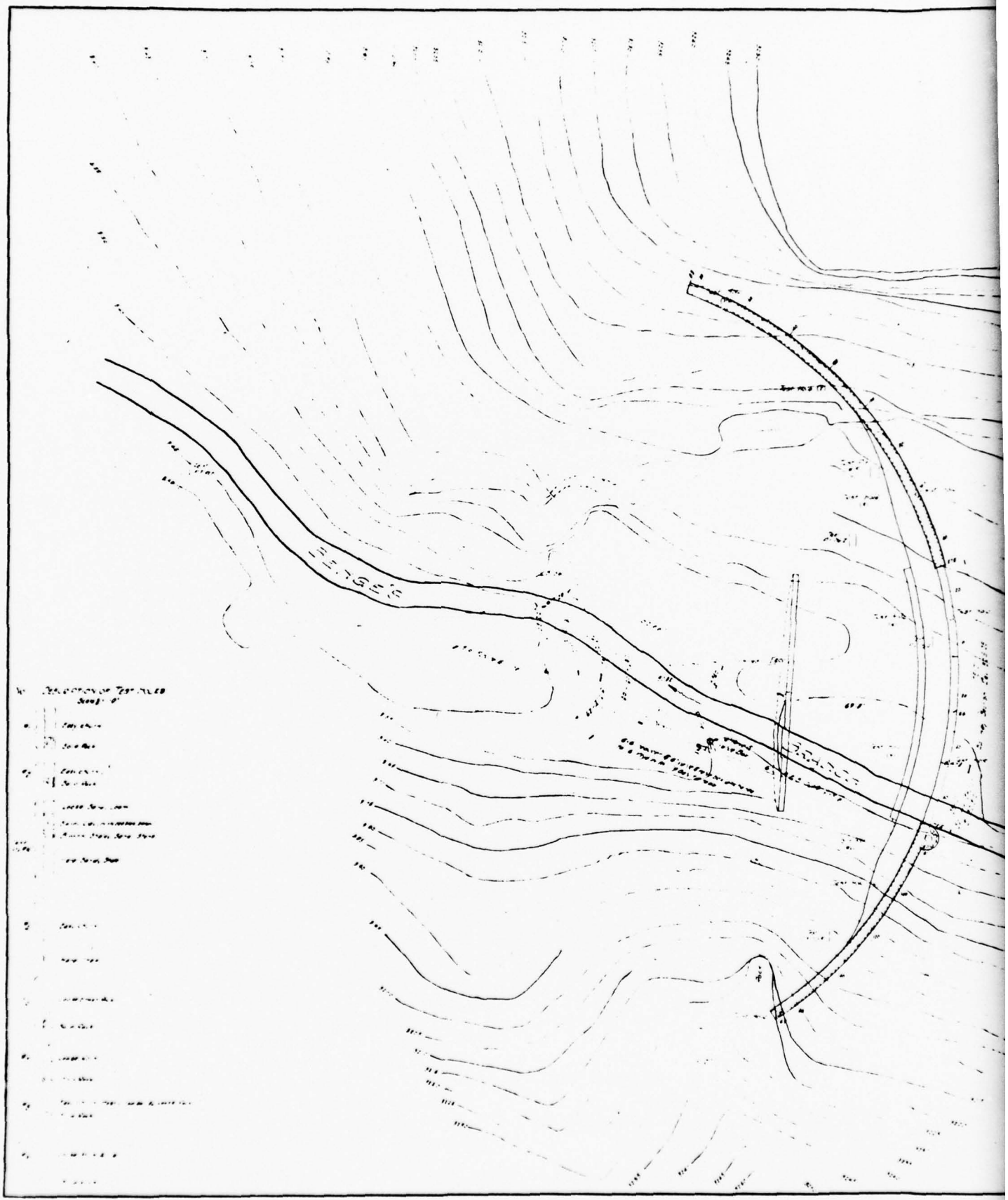
f. The spillway will pass the 100-year flood; both the PMF and one-half PMF will overtop the dam. The owner should give consideration to enlarging the spillway capacity in the future.

APPENDIX I

MAPS AND DRAWINGS



LOCATION MAP
APPENDIX I
FIGURE 1



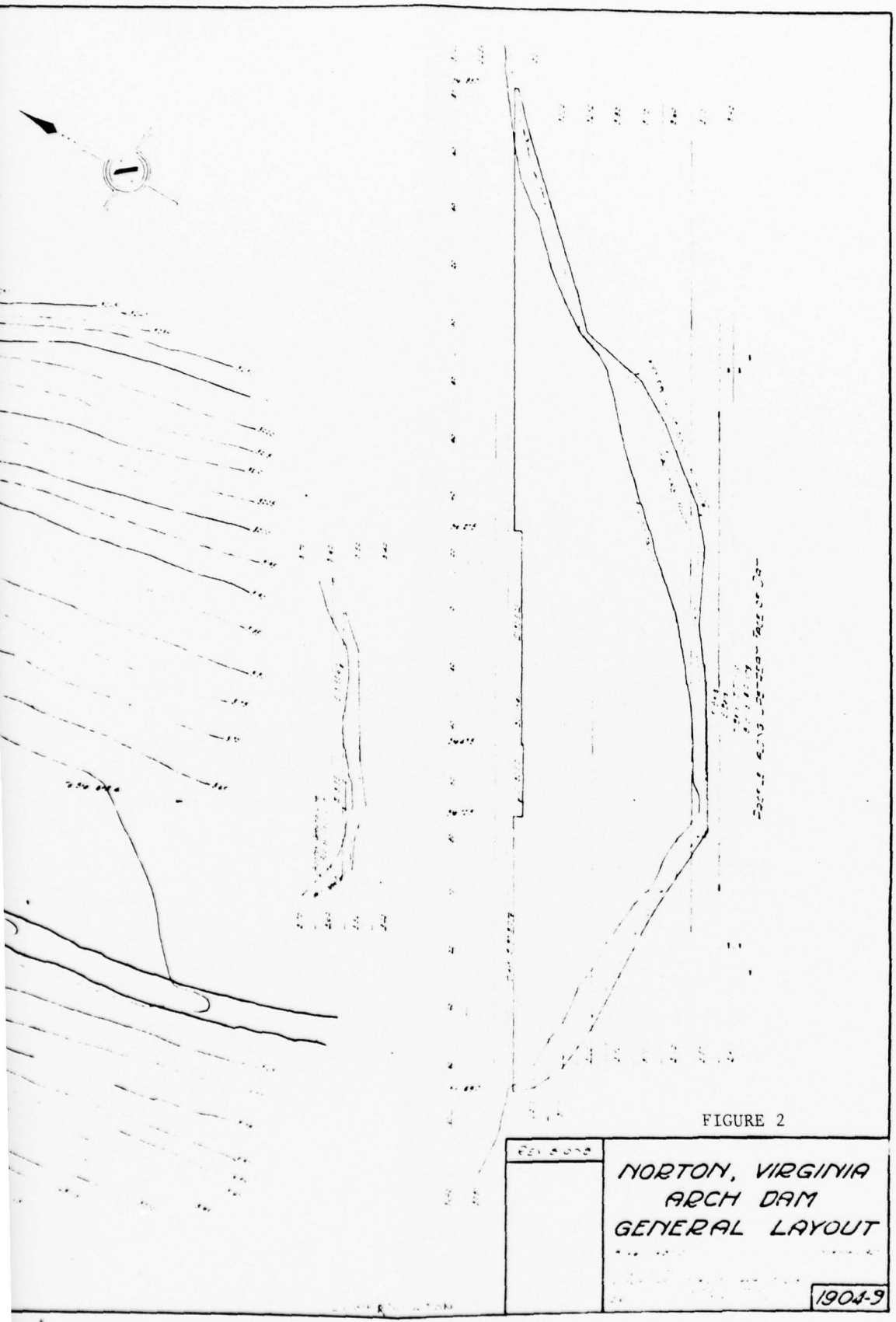


FIGURE 2

NORTON, VIRGINIA
ARCH DAM
GENERAL LAYOUT

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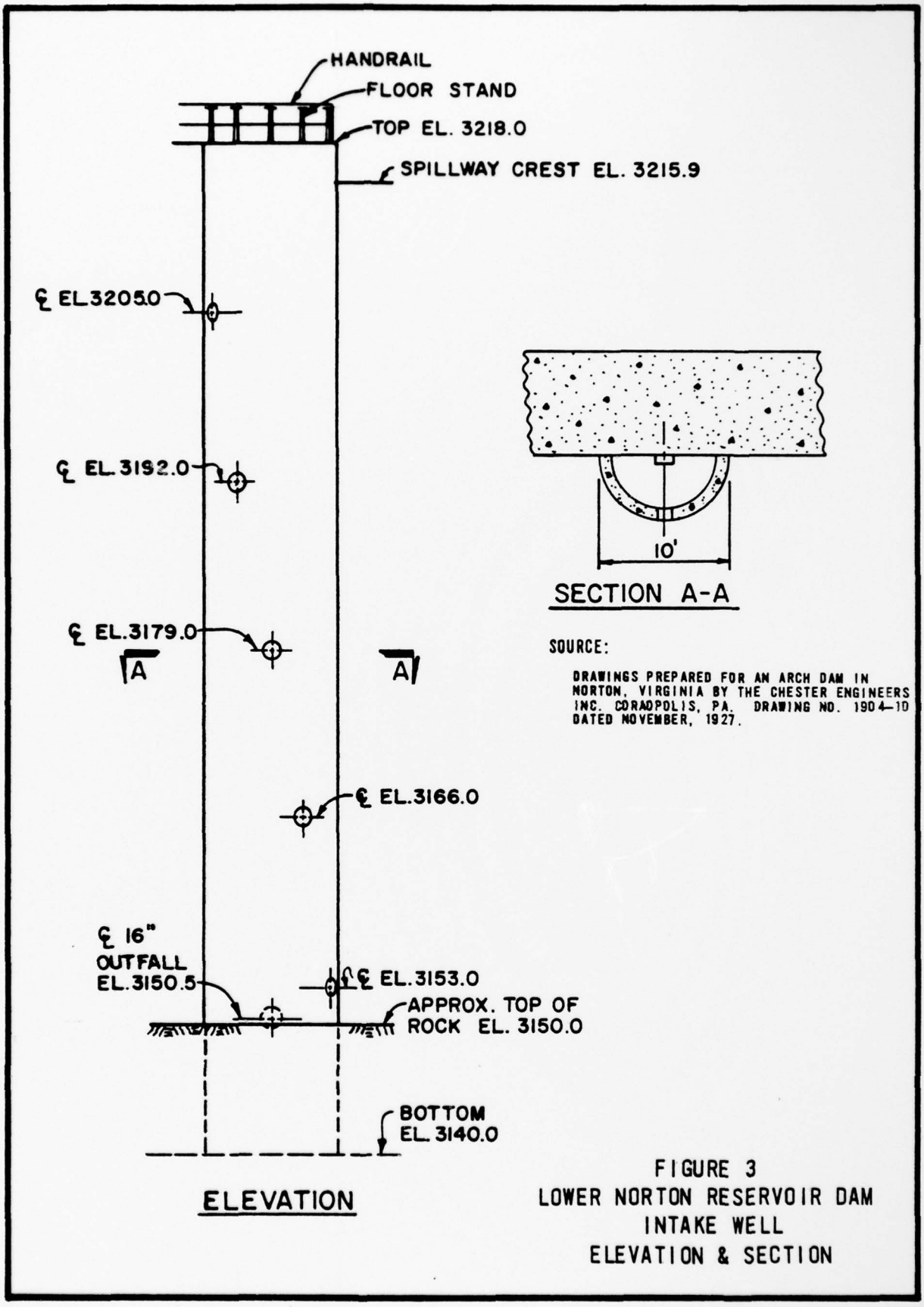


FIGURE 3
LOWER NORTON RESERVOIR DAM
INTAKE WELL
ELEVATION & SECTION

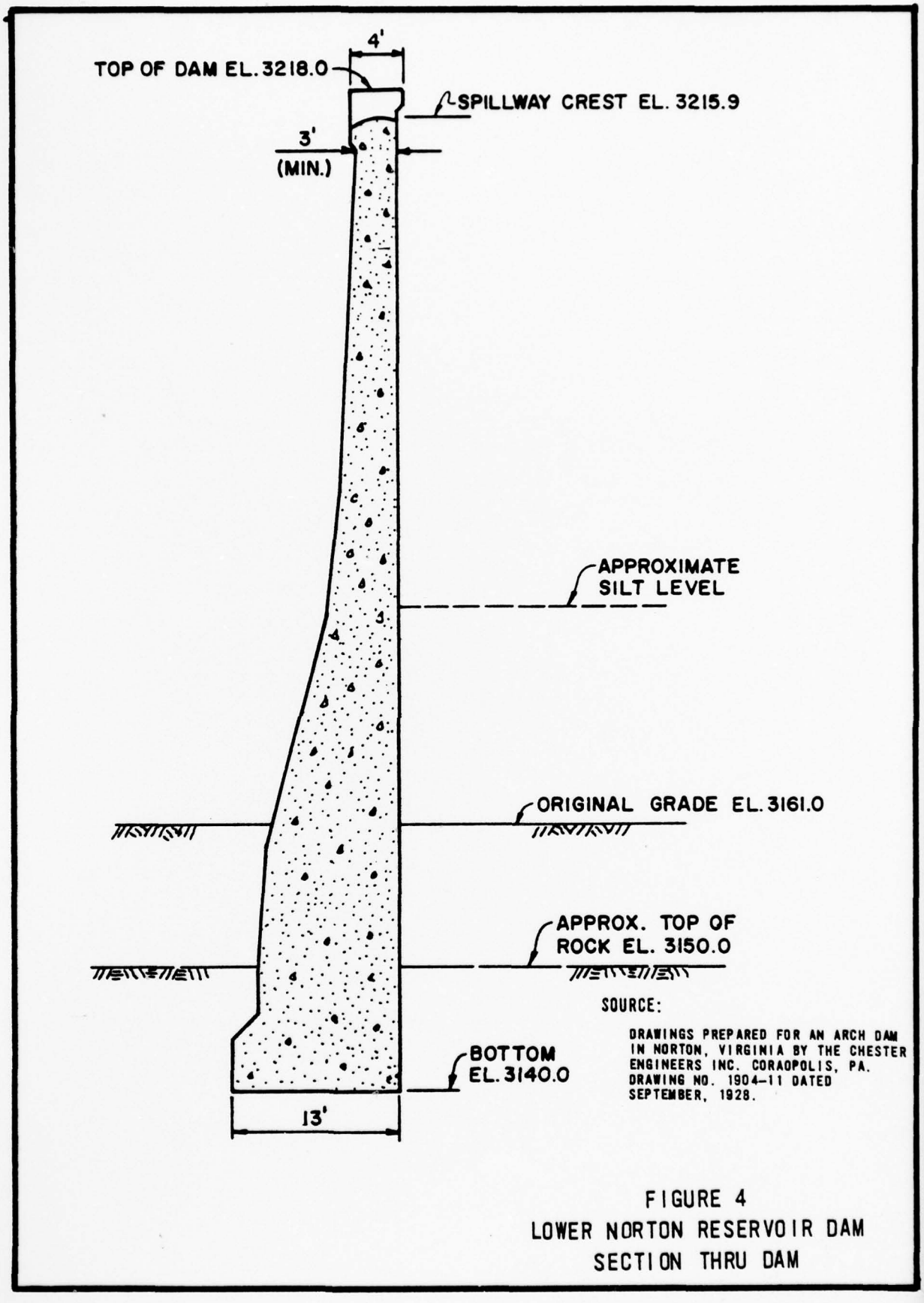
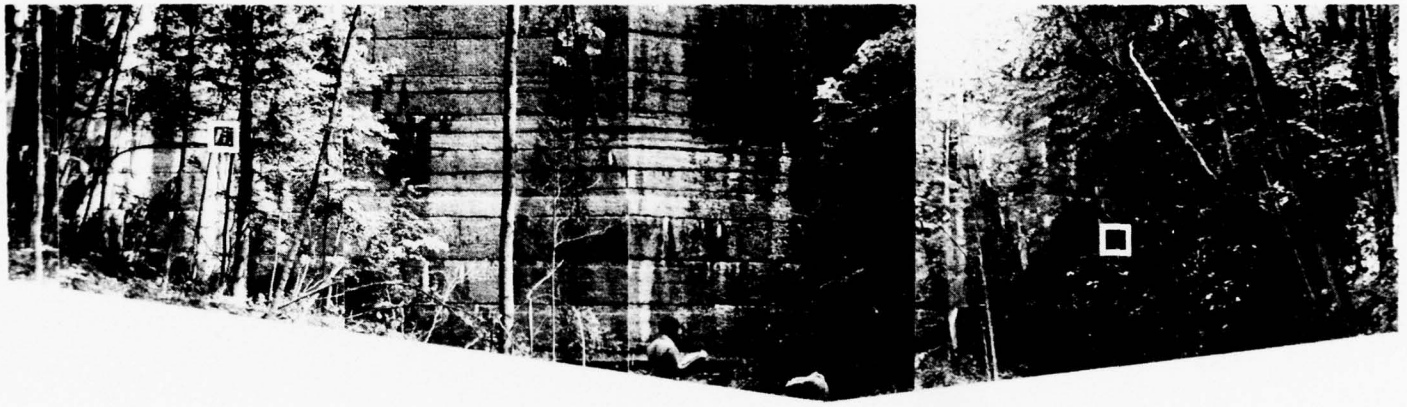


FIGURE 4
LOWER NORTON RESERVOIR DAM
SECTION THRU DAM

APPENDIX II

PHOTOGRAPHS

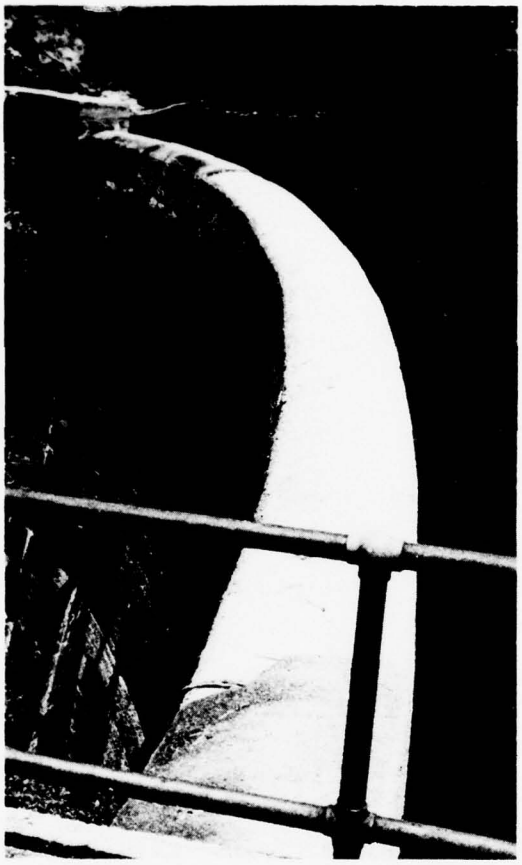


June 1978

MOSAIC OF DOWNSTREAM FACE - NOTE 3 SEEPAGE AREAS INDICATED BY WHITE SQUARES

June 1978

DOWNSTREAM FACE OF ARCH
NOTE: SEVERE SCALING OVER AREAS AND GENERAL JOINT EROSION



June 1978

LOWER LEAK AREA ON DAM -
NOTE APPARENT SEDIMENT
COMING THROUGH DAM

June 1978

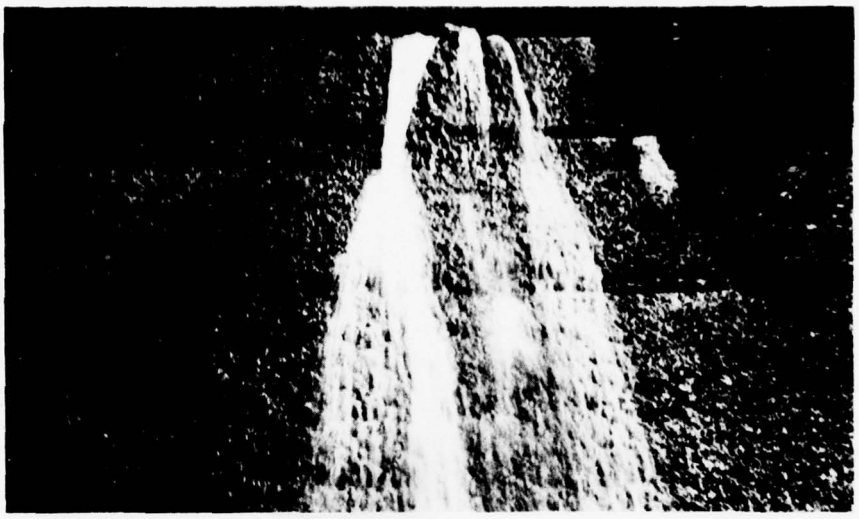
VIEW OF SPILLWAY CREST - NOTE
SEPARATION OF TOP LAYER ALONG
ENTIRE CENTER PORTION AND
VEGETATION EMBRACING RIGHT
SIDE OF DAM

June 1978

CLOSE-UP OF LEFT ABUTMENT
JUNCTION AREA

June 1978

DETAIL OF DOWNSTREAM BASE - NOTE
SEVERE CONCRETE SCALING, ESPECIALLY
AT CONSTRUCTION POINTS

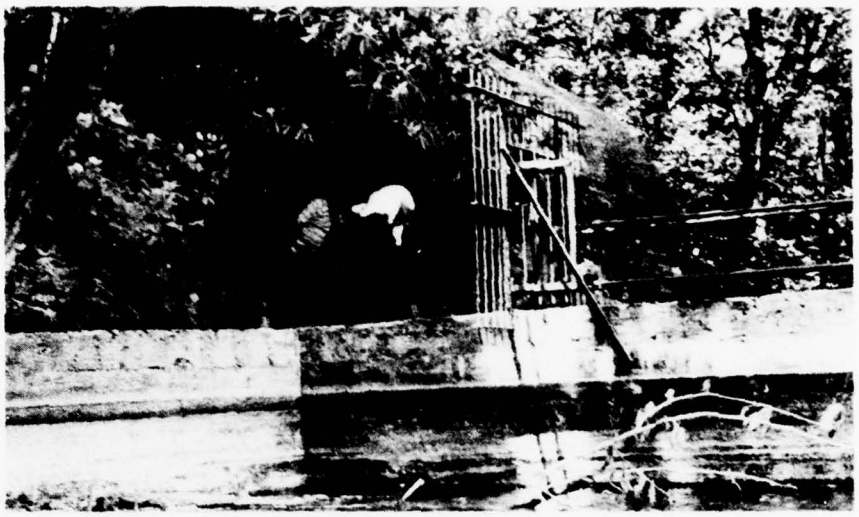


June 1978

CLOSE-UP OF LEAK OF THE OVERFLOW PORTION.
NOTE: CONCRETE EROSION AROUND LEAK

June 1978

CLOSE-UP OF LEAK AREA IN FACE OF DAM
NOTE: CONCRETE EROSION AROUND LEAK



June 1978

LEFT ABUTMENT - NOTE LEDGE ROCK
BEDDING AND GROWTH OF TREES

THREE-FOOT DIAMETER SLUICE GATE -
OPERATING WHEEL HAS BEEN REMOVED.

June 1978

APPENDIX III

FIELD OBSERVATIONS

Check List
Visual Inspection
Phase 1

Name Dam: Lower Norton County: Wise State: Virginia Coordinators: Norfolk District Corps of Engineers

Date(s) Inspection: 12 June, 1978 Weather: Clear Temperature: 82°F

Pool Elevation at Time of Inspection: ±3,212.0 feet m.s.l.

Tailwater at Time of Inspection: 3,162 feet m.s.l. ±

Gilbert Associates, Inc.
Inspection Personnel:

James A. Hagen

Yogesh S. Shah

Nazir A. Qureshi

Also Present:

Joe Baker - City of Norton

Earl Brown - City of Norton

Ralf Gilly - City of Norton

Buck Arnold - Virginia State Water Control Board

James A. Hagen - Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE OR LEAKAGE	Significant quantities of leakage were observed at various locations on the downstream face of the dam. Three of the locations were practically within or near the overflow section, at the horizontal construction joints, and were between 12 feet and 47 feet below the top of the overflow crest. Seepage at each of two of the locations, which were at mid-height of the dam, was approximately 120 to 140 g.p.m. Seepage at the top most location was approximately 30 to 35 g.p.m., while that at the lowest was hardly 15 g.p.m. Several other very small leaks, all at the joints, also were noticed.	The leaks must be monitored and stopped soon; otherwise, they may excessively erode the concrete and corrode the reinforcement.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Abutments consist of fine to medium grained sandstone strata dipping approximately 20 degrees at the left abutment and sloping approximately 50° (±10°) to the horizontal. Excessive growth of trees at the both abutments was noticed. No visible leakage at the junctions was noticed. The slopes at the abutments were apparently stable.	The trees, which can deteriorate the abutment rocks, should be removed.
DRAINS	No drains evident.	
WATER PASSAGES	12-inch or 16-inch diameter pipe for city's water supply.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
FOUNDATION	Competent sandstone observed at the downstream toe. No indication of foundation underseepage.	None
SURFACE CRACKS CONCRETE SURFACES	Localized areas of severe scaling. All construction joints were visible but cracks were apparent only at leak locations.	Owner should repair areas of deteriorated concrete.
STRUCTURAL CRACKING	None visible.	
VERTICAL AND HORIZONTAL ALIGNMENT	Both are apparently good.	None
MONOLITH JOINTS	None	
CONSTRUCTION JOINTS	These joints in the horizontal direction are where the observable leakage emerges from the dam.	See item on "Seepage or Leakage".

OUTLET WORKS

Sheet 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Not applicable - cast-iron-pipe (CIP) outlet conduit.	
INTAKE STRUCTURE	Semi-circular intake tower monolith with dam. All five sluice gate valves inoperative and are in open position.	None
OUTLET STRUCTURE	The 3-foot or 4-foot sluice gate is inoperative; the handwheel has been removed. The 12-inch or 18-inch bypass line to the river is in operation and presently being used to flush the screen on the 8-inch water supply line.	None
OUTLET CHANNEL		
EMERGENCY GATE	Not operable.	

UNGATED SPILLWAY

Sheet 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Middle third of the dam forms the overflow section, the crest of which is approximately 2 feet below the top of the dam. About 70 percent of the section has 1-inch to 2-inch surface spalling.	None
APPROACH CHANNEL	Not Applicable	
DISCHARGE CHANNEL	Rocky bed. Side slopes are wooded, moderately steep but stable. The bed of the channel was disturbed when a new 8-inch CIP supply line was installed in 1977 but was graded and reseeded since then.	None
BRIDGE AND PIERS	Not Applicable.	

INSTRUMENTATION

Sheet 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None were observed.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Densely wooded, inclined approximately 60° (±10°) to horizontal, but apparently stable.	
SEDIMENTATION	There is an estimated 20-foot buildup from bottom per inspection by divers, according to the owner's representative. There was no formal report available describing this effect.	

DOWNSTREAM CHANNEL

Sheet 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Some trees in the channel. The bed of the channel was disturbed when a new 8-inch water supply line was installed in 1977 but was graded and seeded since then.	None.
SLOPES	Side slopes are wooded and moderately steep.	None.
APPROXIMATE NO. OF HOMES AND POPULATION	There are approximately 50 houses below the dam in a narrow channel extending about 2 miles downstream. Most of these have been vacated in anticipation of major highway under construction to provide a southerly bypass for the city of Norton. Beyond that there are approximately 100 buildings and homes in the flow path before the Benges Branch joins the Powell River, nearly 3 miles below the dam. There are about 500 people who could be seriously affected.	

APPENDIX IV

REFERENCES

APPENDIX IV

REFERENCES

1. HEC-1 Flood Hydrograph Package, Hydrologic Engineering Center, U.S. Army Corps of Engineers, January, 1973.

2. Design of Small Dams, U.S. Department of the Interior, Bureau of Reclamation, Second Edition, 1973.

3. "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian," Hydrometeorological Report No. 33, U.S. Weather Bureau, April 1956.

4. "Rainfall Frequency Atlas of the United States," Technical Paper No. 40, U.S. Weather Bureau, May 1961.

5. Upper Norton Reservoir, Phase I Inspection Report, Gilbert Associates, Inc., July 1978.

6. Recommended Guidelines for Safety Inspection of Dams, (Washington, D.C., Department of the Army, Office of the Chief of Engineers).

7. Engineer Technical Letter No. 1110-2-234, Reviews of Spillway Adequacy, (Washington, D.C., Department of the Army, Office of the Chief of Engineers).

APPENDIX V

PREVIOUS INSPECTION REPORTS

TVA 64 (OS-6-68)

UNITED STATES GOVERNMENT

Memorandum

TENNESSEE VALLEY AUTHORITY

TO : C. H. Smith

FROM : R. D. Hodge

DATE : December 15, 1972

SUBJECT: NORTON, VIRGINIA - ENGINEERING DATA ON DAMS AT BENGES BRANCH

Drainage area of upper dam = 0.67 sq. miles.

A check of area files revealed that a complete report had been submitted on the upper dam, No. 2 on Benges Branch, November 29, 1956, titled "Benges Branch Dam and Reservoir Near Norton, Virginia (ASF-923/58)". The writer checked the data in the above report on plans obtained from Norton City Manager, Mr. Milas D. Franks, and found the data to be correct.

No plans or any type of structural data were available on the lower dam, because the City Hall burned in the early 1950's and the plans on the lower dam were destroyed. No structural data had been compiled by the City of Norton since the fire and Mr. Franks did not know where plans for the lower dam could be obtained.

An on-site investigation was made to obtain structural data at Mr. Cauthen's verbal request.

The data contained in this report will refer to the lower dam (No. 1) unless noted otherwise.

The dam was built for the City of Norton to create a reservoir for water supply in the middle of the 1930's.

Location: The dam is located on Benges Branch at Mile 2.77 in Wise County, Virginia, about 0.4 mile south of the Norton City limits. See the attached location map. D.A. = 0.77 sq. miles

Dam: The dam is a concrete arch structure with a width at the spillway crest of 3.2 feet and a width of 10 + feet at the tail-water level on downstream side of dam, shown on Section B-B of the attached drawing. A concrete cap 3.9 feet thick and 2.0 feet high forms the freeboard above the top of the spillway forming the remaining crest of the dam, see Section A-A. The cord length of the arch portion of the dam is 262 feet with a 29 foot wingwall, extending upstream on the left end of the dam.

The elevation of the top of the dam is ~~3127.0~~ 3217.0 and maximum height is 60 feet, (height taken from Capacity of Reservoir Table No. 1). There are three small leaks in the dam with a total estimated flow of fifty gallons per minute.

... Regularly on the Payroll Savings Plan

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FROM COPY FURNISHED TO DDC

Spillways: The main or overflow spillway is located near the center of the dam as shown on attached drawing. The spillway has an effective opening of 95 feet with a crest elevation of 3125.0 feet.

Sluice Tower: There is a 8 foot diameter, semi-circle sluice tower located upstream at the left end of the spillway opening with two outlet pipes. One is a 3 foot diameter pipe enclosed in concrete with an outlet invert elevation of 3074.6 feet MSL. This outlet is not used and the wheel used to open a 4 foot gate has been removed. A 12 inch pipe is used for water supply outlet. The invert elevation is ± 3068.4 MSL.

Elevation	Feet MSL
Top of Dam	~~3127.0~~ 3217.0
Main or Overflow spillway 95 foot long	~~3125.0~~ 3215.0
Invert 3 foot outlet	~~3073.6~~ 3163.6
Invert 12 inch outlet	~~3068.4~~ 3158.4
Tailwater (Min.)	~~3072.3~~ 3162.3
Ground @ Tailwater	~~3072.1~~ 3162.1

Crest of sluice tower at inlet ?

Reservoirs: The lower reservoir, No. 1, has a capacity of 58,000,000 gallons at full pool. The upper reservoir, No. 2, has a capacity of 66,000,000 gallons at full pool. Storage tables for both dams are attached.

Streamflow and Water Use: No records of streamflow have been maintained by the City of Norton at the water treatment plant. Reservoir levels were observed only during dry periods and records are not continuous even during this period. Observed reservoir stages are available only for the period, July 1, 1969 to January 31, 1972. These records were kept on city wet well storage sheets which are attached.

No high flow stages were kept on the reservoirs. However, Mr. Burton, who has worked with City of Norton for twenty to twenty five years, stated that the highest he had seen water over the spillways of both dams was about six inches.

The City of Norton uses 850,000 gallons of water a day, all of which is taken from Benges Branch.

C. H. Smith
December 15, 1972

Operation of Reservoirs: Water is released continuously from the lower dam through the 12 inch pipe and allowed to flow down Benges Branch to a small retention dam at the water plant where it is pumped for filtration and purification.

No operation of the upper dam, No. 2 is made except during dry periods. Water is then released from the upper reservoir to refill the lower reservoir, no. 1.

The overflow spillways are used to pass all flows above crest of spillways.

Summary of Main Features (Lower Reservoir - Mile 2.77)

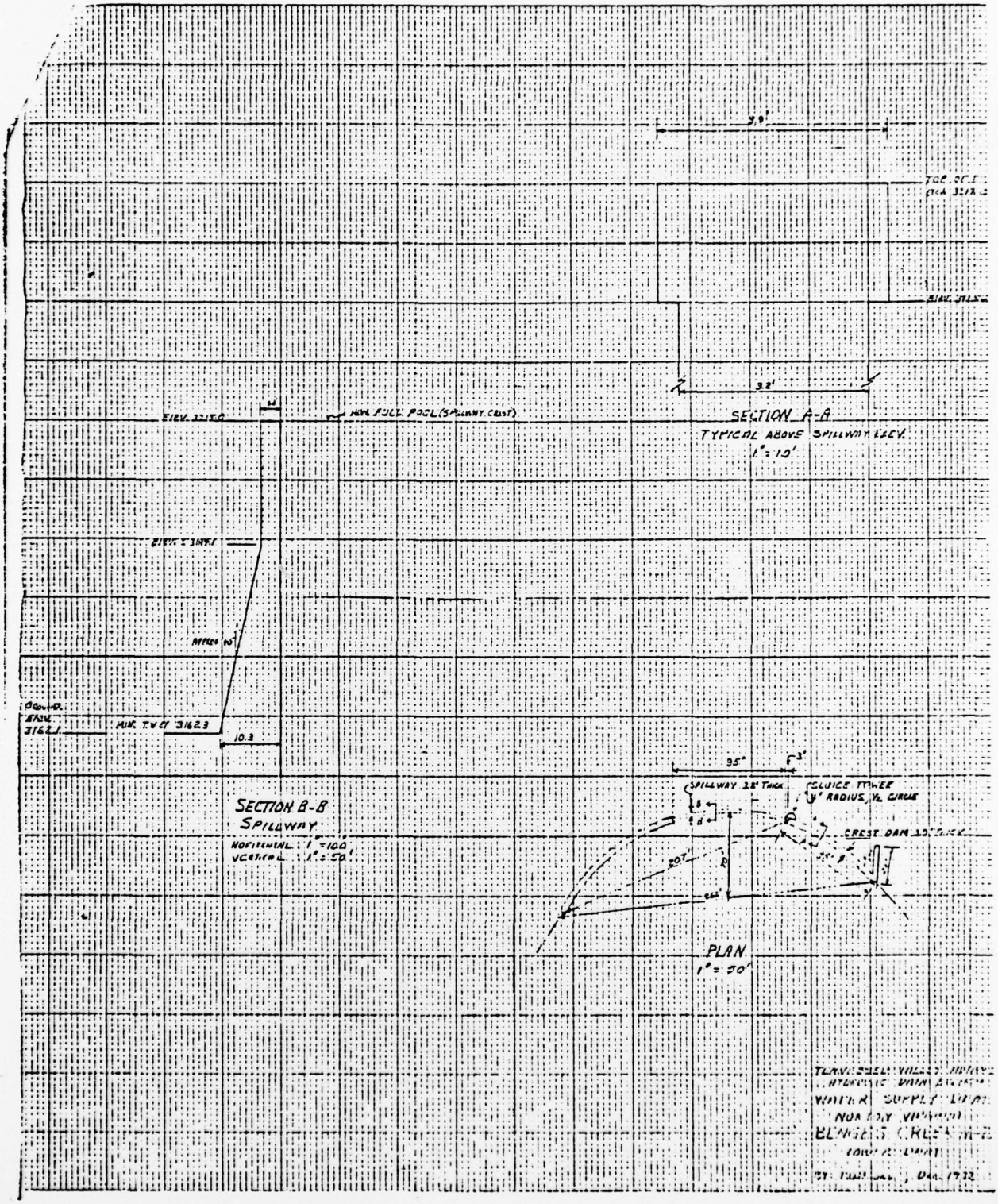
Reservoir Volume		58,000,000 gallons
Elevations - *Crest of Dam*		~~3127.0~~ 3127.0
- Crest of Spillway		~~3125.0~~ 3125.0
- Outlet 3' Pipe	3064.6	~~3074.6~~ (not used)
Cord length of arch of dam		262 feet
Maximum height		60 feet
Width at downstream ground level		10.3 feet
Spillway crown thickness		3.2 feet
Top of Dam Thickness		3.9 feet
Min. TW elev.	3062.3	~~3072.3~~

R. D. Hodge

RDH:hwb
CC: M. D. Cauthen

Attachments: Location Map - Quad. 187 NW
Dam No. 2 Plan and Sections
Capacity of Reservoirs - 2 sheets
Wet Well and Reservoir Stages - 26 sheets
Field Notes: Book 7513, PP. 10


Needmore
Whiteoak Gap
Whiteoak Gap Cem
Strip mines
Mine dump
Norton 2540
Backbone Ridge
Thacker
Cem
Coke ovens
Dorchester
NORTON
(BM Y 39)
(2141)
Strength Cem
Cem
Hollow
Bentley Hollow
Strip mines
Branch
WISE CO
NORTON CITY
Substation
Cem
INTERSTATE
Dooley
Ridge
Res
Lenges
NASHVILLE
AND
Josephine
LOUISVILLE
FINAL
Reservoir
Dorchester Junction
Branch
BM V 21
2000
Reservoir
NORTON CITY
WISE CO
Benges Gap
Cardinal
Hoot
Owl
Hollow
Hoot Owl Church
Machine
Little Stone Gap
Branch
LOWER DAM, NO. 1
UPPER DAM, NO. 2
Valley Lake
Robinett Cem
Valley Chapel
Cem
Marcum Cem
TENNESSEE VALLEY AUTHORITY
HYDRAULIC DATA BRANCH
LOCATION MAP
QUADRANGLE 187 NW
BENGES BRANCH DAMS
NORTON, VIRGINIA


SECTION A-A
TYPICAL ABOVE SPILLWAY ELEV.
1" = 10'
SECTION B-B
SPILLWAY
HORIZONTAL : 1" = 100'
VERTICAL : 1" = 50'
PLAN
1" = 50'
SPILLWAY 28' THICK
CREST DAM 20' THICK
10.3
95°

CAPACITY OF RESERVOIR NO. 1

(Conc. Arch. Dam)

ElevationP	Below Full	Capacity (Gal.)
3215 (full)	0'	58,000,000
	1'	55,740,000
	2'	53,480,000
	3'	51,220,000
	4'	48,960,000
3210	5'	46,700,000
	6'	44,700,000
	7'	42,700,000
	8'	40,700,000
	9'	38,700,000
3205	10'	36,700,00
	11'	35,000,000
	12'	33,300,000
	13'	31,600,000
	14'	29,900,000
3200	15'	28,200,000
	16'	26,760,000
	17'	25,320,000
	18'	23,880,000
	19'	22,440,000
3195	20'	21,000,000
	21'	19,800,000
	22'	18,600,000
	23'	17,400,800
	24'	16,200,000
3190	25'	15,000,000
3185	30'	10,000,000
3180	35'	6,000,000
3175	40'	3,300,000
3170	45'	1,900,000
3165	50'	780,000
3160	55'	140,000
3155 (Empty)	60'	0

November 18, 1963
The Chester Engineers
Pittsburgh 12, Pa.

CAPACITY OF RESERVOIR NO. 2

(Earth Fill Dam)

Elevation	Below Full	Capacity (Gal.)
3287.5 (Full)	0'	66,000,000
3287	0.5	63,300,000
3286	1.5	60,900,000
3285	2.5	58,500,000
3284	3.5	56,100,000
3283	4.5	53,700,000
3282	5.5	51,300,000
3281	6.5	48,900,000
3280	7.5	46,500,000
3279	8.5	44,300,000
3278	9.5	42,100,000
3277	10.5	39,900,000
3276	11.5	37,700,000
3275	12.5	35,500,000
3274	13.5	33,600,000
3273	14.5	31,700,000
3272	15.5	29,800,000
3271	16.5	27,900,000
3270	17.5	26,000,000
3265	22.5	15,000,000
3260	27.5	11,500,000
(Valve 31.5 feet below overflow)		
3255	32.5	6,300,000
3250	37.5	3,200,000
3245	42.5	1,500,000
3240	47.5	320,000
3235 (Empty)	52.5	0

WATER SYSTEM EVALUATION

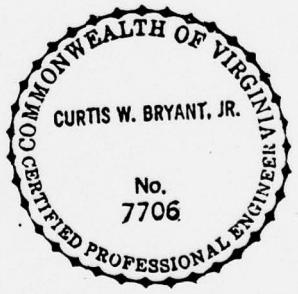
Prepared for

City of Norton

Councilmen:

Ike Fultz, Mayor
George Hunnicutt
W. F. McElroy
Jim Humphreys
Roy Roberts

Milas D. Franks, City Manager



THOMPSON & LITTON, INCORPORATED
ENGINEERS ◻ ARCHITECTS ◻ PLANNERS
WISE, VIRGINIA 24293
MARION, VIRGINIA 24354

Commission No. 2384-00

January, 1976

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APPENDICES

Current pricing estimates for dredging equate to a cost of about $67,000 per million gallons of volume increase. However, this price will depend upon arrangements with a contractor for possible draining of part of the reservoir.

Since potential storage gains by this solution may be limited, it is recommended only that the City make the soundings as a first step.

I. Repair Leaks in Concrete Reservoir. Existing leaks in seams of the concrete reservoir appear to have a water loss of 1 to 2 million gallons per month. Although this water still may reach the plant intake, the chance of ground loss during dry weather is high. Additionally, lack of attention to these leaks could result in serious degradation of the structure in the future.

Two types of repair are possible: grouting on the inside face of the cracks; or a total sealant layer of concrete or vinyl across the inside face of the entire dam. The first solution is less expensive, but the second might be required to prevent further deterioration of the structure.

A testing program is necessary to evaluate the structural soundness of the existing structure. If the leaks are a localized problem, inexpensive grouting can be prescribed. If deterioration is general on the inside face, a sealant layer will insure continued service of the dam.

The estimated cost of the structural testing program is $30,000. A number of qualified structural testing firms are available to conduct such work.

J. Watershed Clearing. It is possible to increase the yield of the existing watershed by removing dense trees and underbrush that impede runoff and replacing these with grasses. If such changes had been made prior to 1975, a 10% increase in runoff during June, July, August, and

APPENDIX VI

CONDITIONS

APPENDIX VI

CONDITIONS

This Report is based on a visual inspection of the dam, a review of available engineering data, and a hydrologic analysis performed during a Phase I investigation as set forth in the U.S. Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams and the contract between the U.S. Corps of Engineers and Gilbert Associates, Inc.

The foregoing inspection, review, and analysis are by their nature limited in scope. It is possible that conditions exist which are hazardous, or which might in time develop into safety hazards, that are not detectable by this inspection, review, and analysis. Accordingly, Gilbert Associates, Inc. cannot and does not warrant or represent that conditions which are hazardous, or which may in time develop into safety hazards, do not exist.